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PERFORMANCE OF SOLDIERS EXECUTING VEHICLE MAINTENANCE TASKS UNDER VARIOUS CONDITIONS OF MASK WEAR

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RESEARCH AND TECHNOLOGY DIRECTORATE

February 1997

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Aberdeen Proving Ground, MD 21010-5423

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DEPARTMENT OF THE ARMY
U.S. Army Edgewood Research, Development and Engineering Center
Aberdeen Proving Ground, Maryland 21010-5423

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In an attempt to obtain information on field operational effectiveness during respirator wear alone, 7 soldier groups of 4 completed preventive maintenance checks and services (PMCS) on an M998 vehicle under conditions of mask and no mask wear during field exercises. Mask wear conditions were selected to obtain performance time data under best, moderate, and worst cases of encumbered vision and communications that a respirator could reasonably impose upon a wearer. Volunteers also rated perceived exertion levels required to perform PMCS tasks and provided subjective feedback concerning what factors of mask wear were most important to them for completing the assigned tasks. Average performance times did not differ significantly between any of the experimental conditions. Self-ratings of perceived exertion were significantly greater for the masked conditions compared to control, but no differences between the different mask concepts were observed. Independent of mask wear condition, the mask factors of visual clarity, focused vision, hearing, and speaking were considered to be most important to subjects for completing PMCS tasks. These results quantify how masks designed with moderate to extreme reductions in visual field and communications capabilities may alter performance of vehicle maintenance tasks under field conditions.

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PREFACE

The work described in this report was authorized under Project No. 10262384A553, Non-Medical CB Defense. This work was started in July 1996 and completed in August 1996.

In conducting the research described in this report, the investigators adhered to Army Regulation 70-25, Research and Development--Use of Volunteers as Subjects of Research, dated 25 January 1991, as promulgated by the Office of The Surgeon General, Department of the Army. Approval for use of the human volunteers was granted by the U.S. Army Edgewood Research, Development and Engineering Center Human Use Committee, Protocol Log No. 9604S.

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PERFORMANCE OF SOLDIERS EXECUTING VEHICLE MAINTENANCE TASKS UNDER VARIOUS CONDITIONS OF MASK WEAR

1. INTRODUCTION

Computer modeling of human performance degradation resulting from the different factors of mask wear would eliminate much of the guess work, cost, and hours currently expended to determine the effects of new mask designs on performance. Although volumes of data exist that address operational effectiveness of troops dressed in full chemical protective ensembles (respirator, overgarments, boots, and gloves) (2,7,8), this type of information is limited for respirator wear alone. Operational performance data that assesses the effects of a respirator in and of itself is needed to gain a better understanding of how mask designs influence performance. For example, if it was known that increasing the field of view of a current mask by 40% caused a 70% increase in operational effectiveness for a particular task, developing a mask with this greater field of view could be pursued. However, if a 40% increase in field of view only resulted in a marginal improvement in performance, incorporating such a design into a new respirator may not be warranted. Thus, it is obvious that having this kind of information would assist designers in achieving the goal of designing the least encumbering respirators possible.

In addition to the shortcomings in data related to the effects of just a respirator on soldier performance, much of the existing mask wear performance data deals primarily with performance of laboratory tasks (3-6). This limitation makes it very difficult to estimate how changes in mask design will affect wearer performance under normal operating conditions in the field. In an attempt to obtain information on field operational effectiveness during respirator wear alone, data was collected while soldiers completed various maintenance procedures on a military vehicle under conditions of mask and no mask wear during field exercises.

Keeping in mind the end goal of modeling soldier performance as it relates to mask design, an attempt was made to assess the influence of different respirator eyepiece and communication component designs on performance. Thus, mask wear conditions were selected to modify both the visual and communications capabilities that a mask affords to a wearer. This approach served as an attempt to gather data about the effects of incremental changes in individual mask components on task performance. In addition, testing included determination of the weighted physiological requirements of each task (e.g., vehicle maintenance: 70% vision, 15% respiration, etc.) and the graded effects of altering the mask factor most important for completion of each task. This information was sought to be incorporated into a future mask wear performance computer model.

2. METHODS

2.1. Subjects

Twenty-eight subjects with a mean age of 20±2 (mean ± SD) years volunteered to participate in this study. Volunteers were obtained from the military personnel assigned to the U.S. Army 143RD Ordnance Battalion, Wheel Vehicle School at Aberdeen Proving Ground, MD.

Volunteers were thoroughly briefed on the nature and purpose of the study and informed consent was obtained from each volunteer upon completion of a volunteer agreement affidavit.

Testing was completed over a four week period at the Brigade Maintenance Exercise (BMX) field site of the 143^{RD} Ordnance Battalion during standard BMX training exercises. Test dates were selected to coincide with scheduled BMX activities on the days of 31 July, 7 August, 14 August, and 21 August 1996. Military Occupational Specialties of the test participants were 63H (Track Vehicle Repairer) and 63W (Wheel Vehicle Repairer). Therefore, all subjects had some experience with tasks involved with maintenance of military type vehicles.

Prior to testing, each volunteer was questioned concerning their current health status and well-being to safeguard that no condition or conditions existed in a volunteer that would jeopardize his or her safety or health during their participation. To certify that volunteers had been questioned regarding their current health status and relevant history of the medical criteria associated with this test, a health history questionnaire was provided for signature as part of the volunteer agreement affidavit. No volunteers reported having conditions that would preclude safe participation in the study.

2.2. Experimental Procedures

Soldiers reported to the BMX site between 1230 and 1300 hours and received an orientation briefing from the BMX Non-Commissioned Officer-in-Charge (NCOIC). Following the orientation, the NCOIC briefly described the mask wear testing that was being conducted concurrently with the BMX activities and requested volunteers for participation in the test. Four volunteers were recruited for participation on the initial PMCS mask wear trial conducted on 31 July 1996. For the three remaining mask wear trials, eight volunteers were recruited for participation. For each mask wear iteration, individuals worked in teams of four to complete the vehicle maintenance tasks.

Following attainment of consent for participation, volunteers were prepped for heart rate monitoring. Heart rate was monitored continuously during testing by recording pulse with a Polar Vantage NV™ Heart Rate Monitor. Subjects were dressed in standard field equipment for all trials including battle dress uniforms, load bearing equipment, and Kevlar vests. However, helmets were not worn at any time during PMCS procedures.

After being prepped for heart rate monitoring, volunteers were sized and fitted for the particular mask or modified mask selected for their use in testing. Pre-test information on the tasks involved in PMCS obtained from the BMX NCOIC influenced the use of masks that were modified to alter the mask wear factors of vision and communications. Thus, masked conditions involved wear of masks that differed according to the visual and communication abilities that they afforded to the wearers. All test conditions are presented in Table 1 along with abbreviated rationale for selecting each masked condition. The selected experimental conditions provided data on task performance for the best, moderate, and worst cases of encumbered vision and communications that a respirator could reasonably impose upon a wearer.

Table 1: Experimental Conditions

Condition	Mask configuration	Rationale
1	None	Control
2	MCU-2/P	Moderate visual field reduction
3	M40 w/degraded visual outserts	Extreme visual field reduction
4	M40	Moderate communications reduction
5	M40 w/degraded voicemitters & hood	Extreme communications reduction

The MCU-2/P respirator is the standard mask used by the U.S. Navy and Air Force and is similar to the U.S. Army M40 except it has a single, panoramic eyepiece that offers a larger field of view than that of the M40 respirator (Appendix A). This mask served as a moderate visual field reduction compared to the control condition (i.e., visual field was reduced approximately 15%). In order to achieve an extreme level of visual field reduction, visual outserts that fit over the outside of the mask eyepieces of the M40 respirator were modified to have approximately two-thirds of their surface area blackened out. When fitted onto the M40, overall visual field of the wearer was reduced approximately 60% from control.

To accomplish the three degrees of communications capabilities, the control condition again served as the best possible condition and the M40 respirator served as the device to elicit a moderate reduction in communications. For the worst case communications condition, M40 voicemitters (both the front and side) were blocked with a thin piece of plastic to absorb sound transmission. The hoods of the masks were also modified by lining them with a cotton material to further increase normal sound attenuation of the hood material. Speech intelligibility and sound attenuation for the moderate and extreme communication reduction conditions were assessed using the techniques of the Rapid Speech Transmission Index (RASTI).

Briefly, the RASTI method measures the reduction in modulation of a transmitted test signal between the speaker and listener positions. The test signal used has certain characteristics which are representative of the human voice. Measured RASTI values vary between zero and one and serve as a measure of speech intelligibility. The RASTI measurements of the moderate communications condition's voicemitters were obtained by placing the standard M40 mask on a headform mounted inside an anechoic chamber. The RASTI test signals were transmitted through the mouth opening of the headform and were measured by microphones positioned at 0.5m, 1m, and 2m from the headform. This test was repeated using the modified voicemitters for the extreme communications reduction condition. Control data were obtained using an unmasked headform condition. Compared to control, at a distance of 1m and with a combined signal and background noise level of 60 dB, unaltered M40 voicemitters showed a 56% reduction in RASTI values. Modified voicemitters reduced RASTI values approximately 70%.

Effects of sound attenuation by the hood materials used in testing were obtained by measuring RASTI values while the microphones were covered with the materials and the headform was unmasked. Control data were obtained using an unmasked headform and uncovered microphone condition. For the normal M40 hood material used in the moderate communications reduction mask condition, RASTI values were identical to control. However,

for the modified hood material, RASTI values were reduced about 32% from control at the 1m distance and with a combined noise level of 60 dB.

Preventive maintenance checks and services (PMCS) were completed on an M998 HMMWV (a.k.a., "humvee") IAW the vehicle's technical manual. Specifically, tasks related to 'before' and 'after' PMCS were performed. Each four person vehicle operator crew completed one masked and one unmasked iteration of vehicle PMCS. The unmasked condition served as the control measure for each group. The order of presentation of the different mask conditions can be found in Table 2.

Table 2: Presentation Order of Mask Wear Conditions

Date	Group Number	First PMCS Trial	Second PMCS Trial
31 Jul 96	1	4	1
7 Aug 96	2	2	1
7 Aug 96	3	3	1
14 Aug 96	4	1	3
14 Aug 96	5	5	1
21 Aug 96	6	1	4
21 Aug 96	7	1	2

See Table 1 for definition of conditions.

Tasks of PMCS included checking vehicle cleanliness, looking for rust and corrosion, and checking bolts, nuts and screws, welds, electric wires and connectors, and hoses and fluid lines. All vehicle deficiencies and shortcomings found during PMCS were documented on DA Form 2404, Equipment Inspection and Maintenance Worksheet, by the four member operator crew during the PMCS (Appendix B). As a check that PMCS was completed properly by each four person team, an NCO oversaw the PMCS procedures and reviewed the completed DA Form 2404 for accuracy and content. Since two groups of four were available for the August test dates, an M998 vehicle was made available for each group. Since deficiencies between the two vehicles were almost identical in number and were similar in content, groups switched vehicles for their second PMCS trial.

2.3. Measurements

Heart rate was recorded every 10 minutes of each PMCS test until completion of the tasks. Heart rate served as a measure of the work intensity of subjects performing the PMCS tasks. Heart rate data were converted to percent predicted maximal heart rate ($\%HR_{max}$) for each subject using the equation 220 minus subject age. Wet bulb, black globe temperatures (WBGT) were monitored throughout testing and were recorded at the beginning and the end of each test day. Since WBGT monitoring equipment was not available during the 7 August test date, only dry bulb and wet bulb temperatures were obtained.

The main dependent variable for completion of the PMCS tasks under the different mask visual and communication encumbrances was performance time. Thus, time to complete all PMCS tasks was recorded for each experimental condition. Once a four-person crew indicated that they had finished vehicle PMCS, the timer was paused until the attending NCO

verified that the operator crew had adequately completed PMCS. Once verification was obtained, the time for successful completion was recorded. If the NCO found errors in crew performance, additional guidance was given to the soldiers by the NCO, the timer was restarted, and the crew continued with PMCS to correct their mistakes. After again signaling that they had finished, the NCO verification process was repeated. This cycle continued until the NCO verified that PMCS was adequately completed.

Following completion of each PMCS trial, volunteers were asked to provide a self-rating of the level of physical exertion required for them to perform the tasks of the PMCS. Ratings of perceived exertion (RPE) were obtained using the Borg RPE scale (Figure 1) (1). In addition, volunteers were asked to provide subjective feedback about which factors of mask wear were most important to them for completing the assigned tasks. A questionnaire was developed to obtain this information (Appendix C). The questionnaire was explained in detail to the subjects prior to its completion.

	Rating of Perceived Exertion
6	
7	Very, very light
8	
9	Very light
10	
11	Fairly light
12	
13	Somewhat hard
14	
15	Hard
16	
17	Very hard
18	
19	Very, very hard
20	

Figure 1. The Rating of Perceived Exertion (RPE) scale.

3. RESULTS

3.1. Environmental Conditions

Environmental conditions from the BMX site for the four test dates are presented in Table 3. Percent relative humidity was determined from the dry bulb and wet bulb temperatures. On the basis of the recorded WBGT temperatures, subjects were not exposed to excessive environmental conditions on any of the four test days.

Table 3: Environmental Conditions for Each Test Day

Date	WBGT (°C)	DB (°C)	WB (°C)	RH (%)
31 Jul 96	25.6	*NA*	*NA*	*NA*
7 Aug 96	*NA*	27.8	24.7	77.5
14 Aug 96	23.0	23.9	23.6	92.5
21 Aug 96	23.4	27.2	23.9	75

NA = not available

3.2. Work Intensity

Analysis of variance (ANOVA) was used to assess differences in $\%HR_{max}$ between measurement periods and between the five experimental mask wear conditions. Significance was accepted at the $p \leq 0.05$ level. No significant main effects of time of measurement or mask condition were found for subject heart rate data. Likewise, no interactive effects of time and condition were observed. Average $\%HR_{max}$ data for each mask wear condition independent of time of measurement showed that subjects worked at approximately 40% of predicted HR_{max} to complete the PMCS tasks (Figure 2).

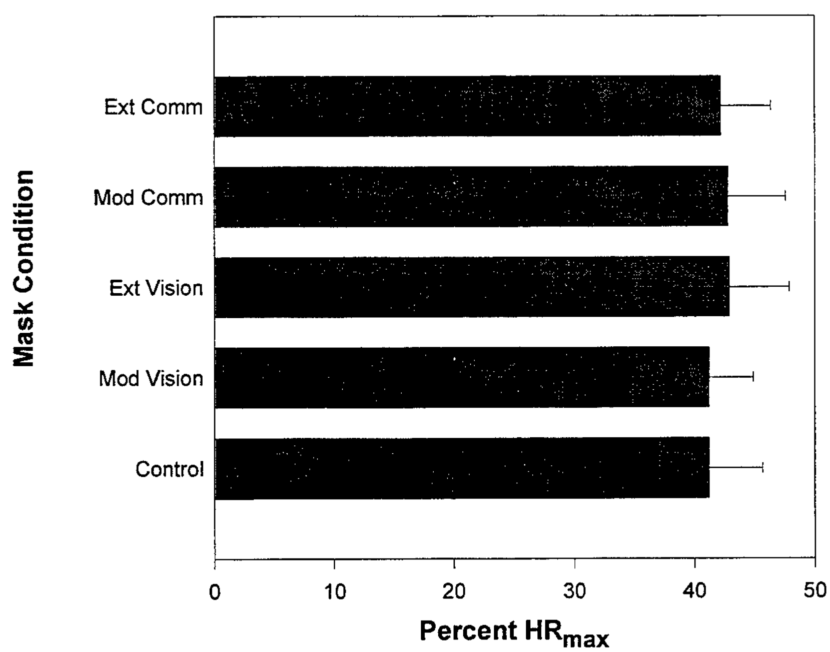

Figure 2. Average (±SD) percent maximal heart rate (HR_{max}) data for each mask wear condition. Mask Conditions: Mod Vision = moderate visual field reduction; Ext Vision = extreme visual field reduction; Mod Comm = moderate communications reduction; and Ext Comm = extreme communications reduction.

Subject self-ratings of perceived exertion for each mask condition were compared using a one-way ANOVA. A *post-hoc* analysis using the Student-Newman-Keuls test with a significance level of $p \leq 0.05$ was performed to identify groups with significantly different RPE scores. Self-ratings of exertion were significantly greater for the masked conditions compared to control (Figure 3). However, no differences between the different mask concepts were observed.

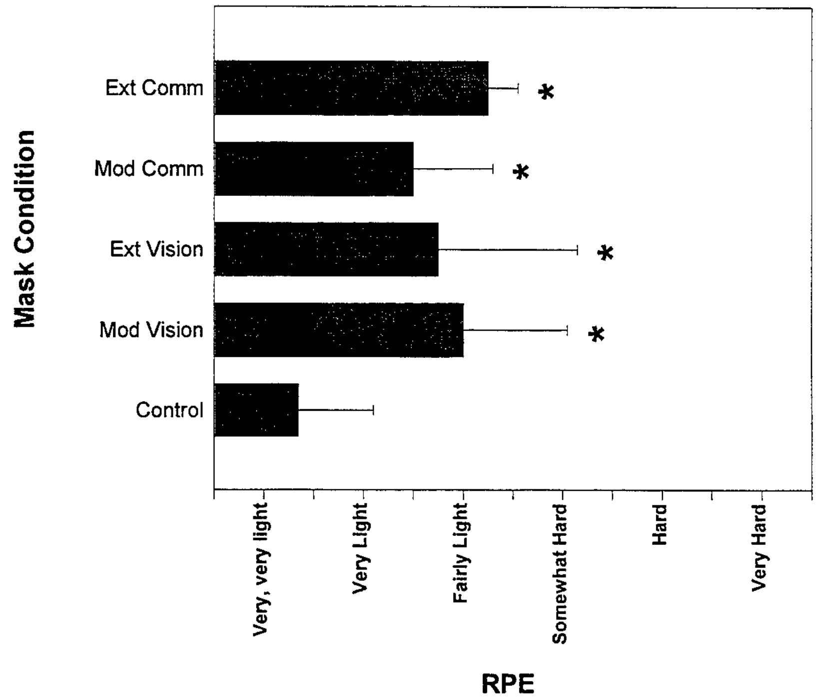

Figure 3. Mean (±SD) ratings of perceived exertion (RPE) for the different mask conditions. Mask conditions are defined in Figure 2. * = significant difference from the Control condition.

3.3. Task Performance Time

Test administrators' observations of soldier performance of PMCS for the no mask (control) condition on 31 July noted that soldiers never inspected the M998 vehicle during the test period. Observers recorded that the group filled out DA Form 2404 based on what they remembered from their initial PMCS trial. Therefore, control condition performance time of this test group was eliminated from analysis.

Average performance times are presented in Table 4. Time to complete each PMCS trial for each experimental condition was compared using a one-way ANOVA with the main effect of mask wear condition. Due to the non-parametric distribution of some of the data and the small number of cases available for analysis, a subsequent nonparametric analysis using a Kruskal-Wallis one-way ANOVA was performed. The results of the analysis showed that performance time did not differ significantly between any of the experimental conditions.

Condition	Mask configuration	Average Performance Time (±SD) (min)
1	Control	24.3±8.6 (n=6)
2	MCU-2/P	31.0±15.6 (n=2)
3	M40 w/degraded visual outserts	47.0±26.9 (n=2)
4	M40	43.0±15.6 (n=2)
5	M40 w/degraded voicemitters & hood	30.0 (n=1)

Table 4: Average PMCS Performance Time Results

Mask performance ratings were calculated for the performance time data using the equation of (time to complete PMCS unmasked/time to complete masked) X 100. Mask performance ratings were calculated for each subject group based on each group's control results. Average performance ratings were compared using the nonparametric Kruskal-Wallis one-way ANOVA. Even though computed mask performance ratings appeared to be very different between masked conditions, no statistical differences were found (Figure 4).

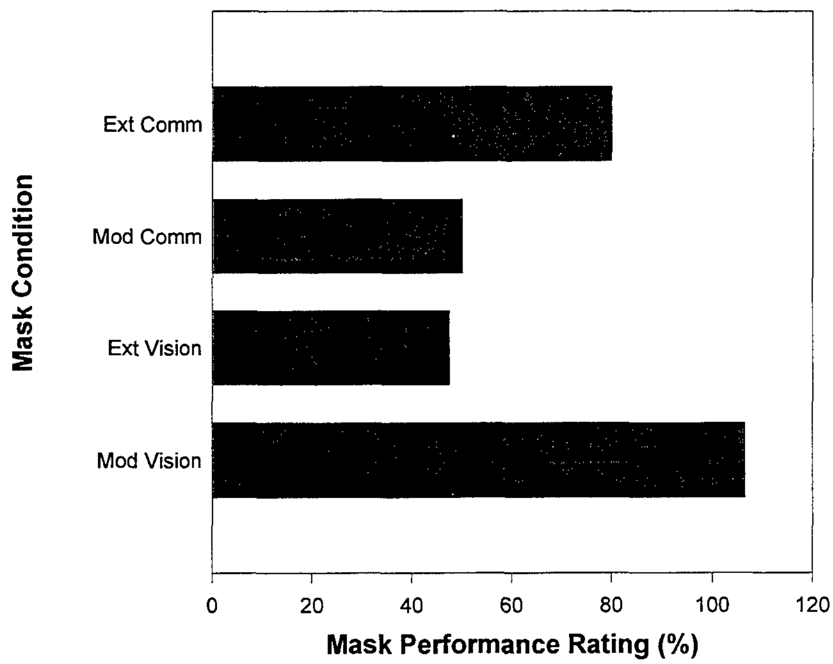

Figure 4. Performance ratings for each experimental condition. Mask Conditions are defined in Figure 2.

3.4. Importance of Mask Wear Factors

For the questionnaire data, mask wear factor scores were averaged for each experimental condition based on volunteer rankings. Again, analysis of variance was performed to determine statistical differences in mask factor rankings between mask wear conditions. Nonparametric data were analyzed using a Kruskal-Wallis one-way ANOVA. Significance was accepted at the $p \leq 0.05$ level. Average rankings of the different mask factors were statistically similar between mask wear conditions within each mask factor category. Independent of experimental condition, the mask factors of visual clarity (clearv), focused vision (focusv), hearing, and speaking averaged scores of 8 or better indicating that these factors were considered to be very important for subjects to complete the procedures of vehicle PMCS (Figure 5). The mask factors of breathing comfort (breathcf), ability to concentrate (concen), equipment compatibility (equipcom), freedom of head movement (headfree), thermal comfort (thermcf), and wide area vision (widev) received ratings between fairly important and very important for completing the tasks. On average, the factor of drinking was ranked the lowest by subjects.

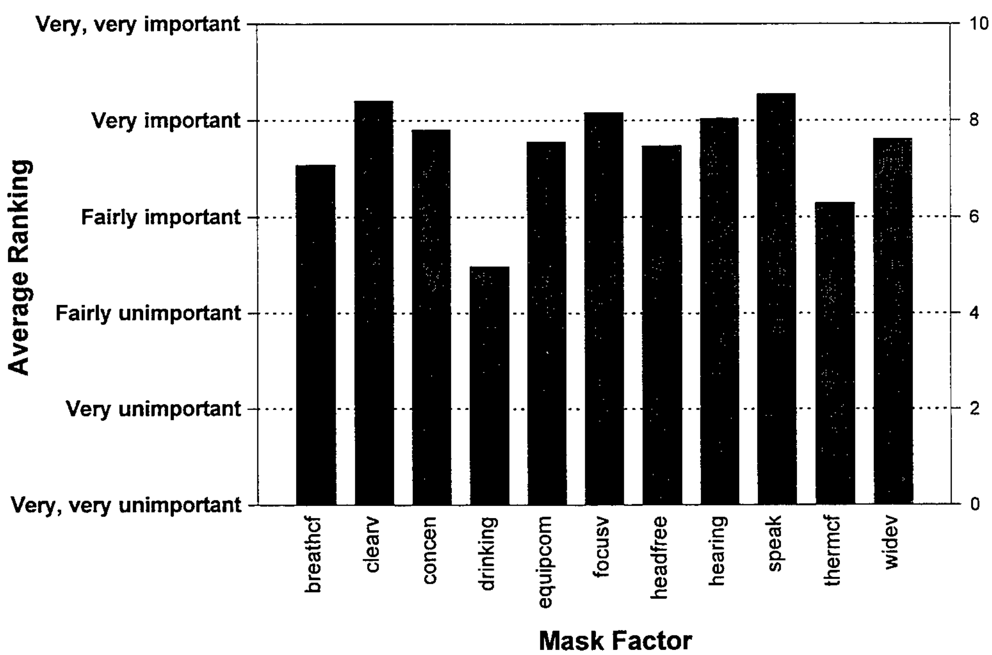

Figure 5. Relative importance of each mask factor for completion of the PMCS tasks.

4. DISCUSSION

The data obtained in this study provided some insight related to potential field operational effectiveness of soldiers wearing respirators while completing maintenance

procedures on a military vehicle. First, subjects reported that the level of effort required to complete PMCS tasks was significantly greater during mask wear than under control conditions. Ratings of perceived exertion indicated that respirator configurations resulted in a perceived higher level of effort even though subjects worked at the same percentage of their maximal heart rate for all trials. However, even though subjects perceived that they were working harder, the performance time results of the PMCS trials suggest that moderate to extreme reductions in respirator visual field and communications parameters do not significantly alter time to complete PMCS tasks. Average performance times were greater for all mask wear iterations of PMCS compared to control, but the small group sample sizes and the large variances observed for the masked trials (Table 4) prevented the differences from reaching statistical significance.

Mask performance ratings were calculated to quantify the relative performance of soldier groups while masked compared to unmasked. For the mask visual field modification trials, mask performance ratings were 106% and 47% for the moderate and extreme reductions, respectively. Therefore, the moderate visual field reduction imposed on the soldiers during wear of the MCU-2/P respirator caused no decrements in performance compared to the unmasked condition. In like manner, the extreme visual field reduction caused by the modified visual outserts of the M40 respirator resulted in a 53% performance decrement. Even though the performance rating differences between the visual field alterations were not statistically significant, the results suggest that PMCS performance would be unaltered during mask wear if the mask being used did not degrade visual field by more than 15%. In addition, if the standard M40 mask trials are also considered as a severe (i.e., moderate-to-extreme) visual field reduction condition, the argument could be made that a 40% visual field reduction (standard M40) impacts PMCS performance to the same extent as does a 60% reduction (modified M40).

Results of the communication modification trials were not as orderly as the visual field data. Again, performance time data were statistically similar between the control, moderate, and extreme communications reduction conditions. Based on mask performance rating calculations, moderate reduction in communications capabilities during mask wear (standard M40) resulted in a 50% reduction in soldier performance of PMCS. However, contrary to what was anticipated, the extreme condition (M40 with degraded voicemitters and hoods) resulted in only a 20% performance degradation (performance rating of 80%). The inability to see a greater performance decrement under moderate compared to extreme communications modifications probably resulted from the fact that only one subject group was exposed to the extreme reduction condition.

Other possible contributing factors to the unexpected differences found between moderate and extreme communications reduction conditions may relate to the observed differences in soldier techniques used to complete the vehicle PMCS for the two different conditions and in group motivation. One group that participated in the moderate communications reduction trial was very organized from the beginning of the PMCS trial. This particular group started PMCS by designating someone to serve as the keeper of the vehicle operator's manual with the duty of reading PMCS steps out-loud to two others of the group who then performed the specific vehicle checks. The last member of this group recorded reported vehicle deficiencies on DA Form 2404. In contrast, the second group exposed to the moderate communications reduction condition was very unorganized and received two incomplete PMCS ratings from the attending NCO before they were finally rated to have adequately completed the PMCS tasks. This group also appeared to be unmotivated. The extreme communications

reduction group was very organized and completed tasks in a manner similar to the one moderate group. However, the extreme reduction group was very motivated and made light of the mask configuration that they were wearing. In addition, they also reverted to using hand signals in addition to shouting to communicate with one another. These slight technique differences contributed to limiting their performance degradation to 20% from their control trial.

The mask factor questionnaire used in the study was designed to obtain user feedback as to the relative importance of each mask wear factor to successful completion of the PMCS tasks. Since the purpose of the questionnaire was to assess factors of mask wear, factors related to other ergonomic factors needed to complete tasks related to vehicle maintenance (e.g., manual dexterity, touch sensitivity, body positioning, etc.) were not included in the questionnaire. Results of the questionnaire showed that both communications factors of speaking and hearing were considered to be very important to soldiers to complete PMCS tasks. The same was true for the visual factors of clear vision and focused vision. These findings support the hypothesis that vision and communication are the most important physiological factors of mask wear for completion of PMCS tasks. It could also be argued that these factors were rated as highly important because they were the mask factors that were modified for testing. However, the fact that no differences in factor ratings were found between experimental conditions suggests that mask factor rankings were more a function of the task than of the modifications made to the respirators.

In terms of mask design, the results of this study have the following applications. First of all, this study provides data of operational performance of soldiers exposed to mask wear without the rest of the chemical and biological individual protective ensemble. Secondly, performance decrements in completion of PMCS tasks have been quantified for the specific reductions in visual field and communications capabilities that a mask affords to a user. And, finally, the results of the mask factor questionnaire identified the main physiological factors of mask wear needed to perform the PMCS tasks. With this information, some generalizations about expected operational performance of tasks similar to the PMCS tasks performed in this study during mask wear can be made. However, caution must be used because the results of this investigation are based on a small number of subject groups.

Finally, one factor that was not directly addressed in this study was the potential for interactive effects on PMCS performance when both visual and communications abilities were degraded concurrently. A complete assessment of potential interactive effects was not made to try to simplify testing as much as possible. In addition, every effort was made to limit our interference with normal BMX activities. However, an indirect observation of the interactive effects of reduced visual and communications capabilities of a mask can be made from the data obtained on both the MCU-2/P and standard M40 respirators. The MCU-2/P, used as the moderate visual field reduction condition, differs from the M40 (moderate communications reduction) only by lens design. The hood materials and voicemitters are the same. Thus, the MCU-2/P could be considered as a combined moderate visual field/moderate communications reduction condition. Likewise, the M40 could be viewed as a combined severe visual field/moderate communications reduction condition. Performance ratings for the MCU-2/P and M40 were 106% and 50%, respectively. Therefore, since the conditions differ only by visual field capabilities, visual field could be weighed as being more influential on PMCS task completion than communications capabilities. However, it must be remembered that the size of sample population was small and that other factors such as subject motivation may have influenced these findings.

5. CONCLUSIONS

The findings of this investigation showed that soldier performance, measured by time to adequately complete the tasks of vehicle PMCS, is degraded during mask wear. However, performance degradations were not linear for the imposed levels of visual field and communications reductions during mask wear. Large variations in subject group performance times and techniques, as well as the limited number of subject groups tested, limits our ability to say that the recorded performance decrements are what should be expected from soldiers wearing masks with visual field and communications design features similar to the modifications assessed in this study. Even so, the data provides some understanding of how masks with moderate to extreme reductions in visual field and communications capabilities alter performance of vehicle maintenance tasks. This information will be invaluable for the development of the mask wear performance database to be used with the future respirator encumbrance model.

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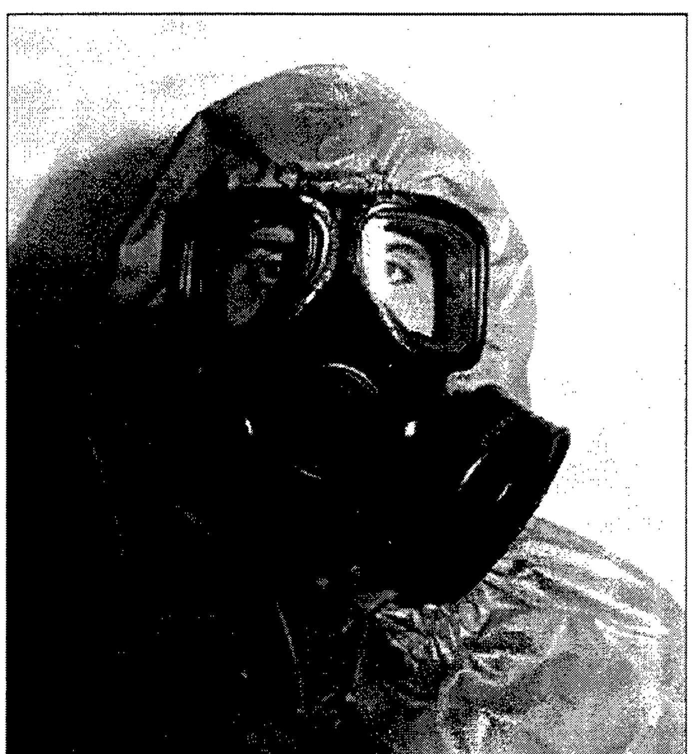
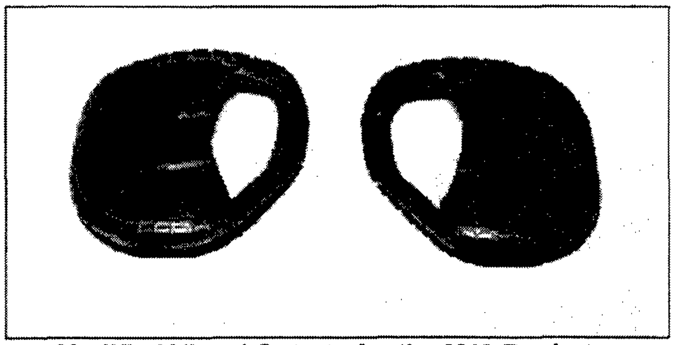
APPENDIX A

Photos of Masks and Mask Configurations

MCU-2/P Respirator



M40 Respirator


Modified Visual Outerts for the M40 Repirator


M40 Respirator with Modified Outserts

M40 Respirator with Modified Hood Attached

APPENDIX B

DA Form 2404, Equipment Inspection and Maintenance Worksheet

EQUIPMENT INSPECTION AND MAINTENANCE WORKSHEET

For use of this form, see DA PAM 738-750 and 738-751; the proponent agency is DCSLOG

1. ORGANIZATION					2. NOMENCLATURE AND MODEL	
3. REGISTRATION/SERIAL/NSN	4*a*. MILES	*b*. HOURS	*c*. ROUNDS FIRED	*d*. HOT STARTS	5. DATE	6. TYPE INSPECTION

7. APPLICABLE REFERENCE

TM NUMBER	TM DATE	TM NUMBER	TM DATE

COLUMN a – Enter TM item number.

COLUMN b – Enter the applicable condition status symbol.

COLUMN c – Enter deficiencies and shortcomings.

COLUMN d – Show corrective action for deficiency or shortcoming listed in Column c.

COLUMN e – Individual ascertaining completed corrective action initial in this column.

STATUS SYMBOLS

"X" – Indicates a deficiency in the equipment that places it in an inoperable status.

CIRCLED "X" – Indicates a deficiency, however, the equipment may be operated under specific limitations as directed by higher authority or as prescribed locally, until corrective action can be accomplished.

HORIZONTAL DASH "(-)" – Indicates that a required inspection, component replacement, maintenance operation check, or test flight is due but has not been accomplished, or an overdue MWO has not been accomplished.

DIAGONAL "(/)" – Indicates a material defect other than a deficiency which must be corrected to increase efficiency or to make the item completely serviceable.

LAST NAME INITIAL IN BLACK, BLUE-BLACK INK, OR PENCIL - Indicates that a completely satisfactory condition exists.

FOR AIRCRAFT - Status symbols will be recorded in red.

ALL INSPECTIONS AND EQUIPMENT CONDITIONS RECORDED ON THIS FORM HAVE BEEN DETERMINED IN ACCORDANCE WITH DIAGNOSTIC PROCEDURES AND STANDARDS IN THE TM CITED HEREON.

8*a*. SIGNATURE *(Person(s) performing inspection)*	8*b*. TIME	9*a*. SIGNATURE *(Maintenance Supervisor)*	9*b*. TIME	10. MANHOURS REQUIRED

TM ITEM NO. *a*	STATUS *b*	DEFICIENCIES AND SHORTCOMINGS *c*	CORRECTIVE ACTION *d*	INITIAL WHEN CORRECTED *e*

DA FORM 2404, APR 79 — Replaces edition of 1 Jan 64, which will be used — USAPPC V1.10

APPENDIX C

Mask Factors Ranking Questionnaire

Name ____________________ Number ___________ Date ______________

Experimental condition: 1 2 3 4 5

Rate each factor according to its relative IMPORTANCE to you for completing the assigned task using the following scale:

0	VERY, VERY UNIMPORTANT
1	
2	VERY UNIMPORTANT
3	
4	FAIRLY UNIMPORTANT
5	
6	FAIRLY IMPORTANT
7	
8	VERY IMPORTANT
9	
10	VERY, VERY IMPORTANT

FACTORS (circle rating)

speaking	0	1	2	3	4	5	6	7	8	9	10
wide area vision	0	1	2	3	4	5	6	7	8	9	10
ability to concentrate	0	1	2	3	4	5	6	7	8	9	10
hearing	0	1	2	3	4	5	6	7	8	9	10
breathing comfort	0	1	2	3	4	5	6	7	8	9	10
thermal comfort (not too hot/cold)	0	1	2	3	4	5	6	7	8	9	10
focused vision	0	1	2	3	4	5	6	7	8	9	10
drinking	0	1	2	3	4	5	6	7	8	9	10
freedom of head movement	0	1	2	3	4	5	6	7	8	9	10
visual clarity	0	1	2	3	4	5	6	7	8	9	10
equipment compatibility	0	1	2	3	4	5	6	7	8	9	10